634.1 DESCRIPTION

This work consists of furnishing, installing and maintaining required traffic control devices in accordance with the current edition of the Federal Manual on Uniform Traffic Control Devices.

634.2 MATERIALS

Traffic and traffic control devices shall conform to and be maintained in accordance with the requirements of Section 984, and the current editions of the Federal Manual on Uniform Traffic Control Devices and Standard Highway Signs, issued by FHWA.

Traffic control devices shall meet the crashworthy requirements of the National Cooperative Highway Research Program Report 350 (NCHRP 350) for Category I & II devices.

A. Category I traffic control devices include low mass, single piece traffic cones, tubular markers, single piece drums, and delineators. Auxiliary lights or signs shall not be attached to these devices, unless approval has been granted by FHWA. These devices shall be certified as being NCHRP 350 crashworthy by the manufacturer.

B. Category II traffic control devices include those which are larger than the Category I devices and may weigh up to 100 pounds. This includes plastic barricades and portable sign supports. Acceptable Category II devices are those which have been crash tested and have received an acceptable letter from the Federal Highway Administration.

C. Category III traffic control devices include barriers or other fixed or high mass devices, including portable sign trailers. Portable sign trailers must be crash tested and have received an acceptance letter from the FHWA. All other Category III traffic control devices put into service prior to October 1, 2002 will be allowed for use until October 1, 2007.

It shall be the responsibility of the Contractor to provide documentation that all devices meet the applicable NCHRP 350 requirements.

Metallic barrels or drums will not be allowed.

Designated construction and maintenance work zone traffic control devices shall be sheeted with retroreflective sheeting material in accordance with the requirements of Section 984.

Paint used for temporary pavement marking shall meet the same specification for permanent pavement marking in Section 980.

Glass beads shall be used to reflectorize the temporary traffic paint. The glass beads shall conform to the requirements of Section 981.

Pilot Cars shall conform to Section 984.

634.3 CONSTRUCTION REQUIREMENTS

A. General: The Contractor shall furnish, install and maintain required traffic control devices and pavement marking material. The Contractor shall provide a sufficient number of flaggers and take necessary precautions for protection of the workers, work area and the safety of the traveling public. Flaggers will be required where work activity and/or equipment encroaches into a lane open to traffic.

Standards for flaggers and flagging practices shall conform to Part VI of the MUTCD. The Contractor shall provide each flagger with a copy of the "Traffic Flagging Handbook" booklet. These booklets are available from the Department.

The Contractor shall furnish certified flaggers to perform project traffic control. The minimum age for flaggers shall be 18 years old. Flagger training and certification is available at some Department Area offices and from the Associated General Contractors (AGC). All flaggers shall complete a flagger training course and pass a written test to become certified. Flagger certification is valid for a period of two years. All flaggers shall be certified in South Dakota prior to flagging on the project. Flaggers shall carry proof of certification while flagging on Department projects.

All flaggers are required to wear a vest, shirt, or jacket that is dual colors of yellow, orange, strong yellow green, or a fluorescent variation of these same colors. A strong yellow green, orange, or fluorescent strong yellow green hard hat, hard hat cover, or cap should be worn to increase visibility to approaching traffic.

The vest, shirt, jacket, hard hat, hard hat cover, and cap shall be retroreflective when used in low light conditions. Flagger workstations shall be illuminated from ½ hour after sunset to ½ hour before sunrise.

Flaggers shall be properly equipped with a STOP/SLOW sign for the control of traffic. The sign should be mounted on a staff from five to seven feet long, from the bottom of the sign to the ground. All devices and their use shall comply with Part VI of the current MUTCD, unless otherwise specified in this provision.

All traffic control devices shall be kept in proper position, clean, and legible at all times. Damaged devices shall be replaced within 24 hours, or as directed by the Engineer. The Contractor shall make weekly inspections after dark to verify that the overall traffic control system is adequate and that all devices are legible at night.

Shadow vehicles shall be used for brooming operations unless otherwise directed. They shall be a four-wheel motor vehicle with a flashing amber light and shall have a "ROAD MACHINERY AHEAD" sign mounted in a prominent position, visible to approaching traffic. The broom shall be equipped with a flashing amber light.

Barricades, delineators, vertical panels, cones, drums, and tubular markers used to separate opposing traffic shall be bi-directional.

Traffic control devices shall be immediately removed or covered when the need for such devices no longer exists. When devices are removed, they should be stored off the project or as close to the right-of-way line as possible.

Warning lights shall be six to eight inches (150 mm to 200 mm) in diameter and operate during hours when the hazard or regulation exists. Continuous operation 24 hours a day is required when the hazard or regulation is in existence throughout this period.

When used in conjunction with signs, the warning light shall not be located within the face of the sign, nor more than 12 inches (300 mm) above the top of the sign. When used with barriers and channelizing devices, the warning light shall be at least three feet (900 mm) and not more than six feet (1800 mm) above the pavement.

The Contractor shall designate an employee whose responsibility is the maintenance of traffic, 24 hours a day, 7 days a week. The person so designated must have training and experience in the field of construction traffic control and be knowledgeable about the MUTCD. The employee selected must be approved by the Engineer. The name, phone number, and location of the person(s) shall be provided to the Department, SD Highway Patrol, county sheriff's office, and the local city police department.

B. Temporary Pavement Marking:

Temporary pavement markings shall be maintained in good condition until the permanent striping is in place, or until final acceptance of the project.

1. **Temporary Pavement Marking Tape Type 1** will generally be limited to temporary striping and temporary marking on pavement to be removed or covered with an additional lift or for other uses that do not require removal of the tape. It may also be used and subsequently removed on tangent sections along normal lane line locations.

2. **Temporary Pavement Marking Tape Type 2** is required on all temporary lane transitions and tapers involving pavement that is the final driving surface.

3. **Temporary Centerline and No Passing Zones:** All roadways open to traffic (including newly paved and roto milled surfaces, asphalt surface treatment, seal, prime, and tack coats) shall have temporary dashed centerline markings, no passing zone markings, and applicable lane lines placed prior to nightfall. Interstate highways shall also be marked with edge lines. All markings shall be placed prior to nightfall.

   Unless otherwise shown on the plans, centerline and the applicable lane lines may be temporarily marked by removable road markers, pavement marking tape, or traffic paint.

   The material used to mark the no passing zone stripes shall be the same type of material used to mark the temporary dashed centerline, unless otherwise approved by the Engineer.

   The Contractor shall take the steps necessary to assure that the temporary markings on the final surface will match the markings on the existing surface.

The Engineer will determine locations and limits of no passing zones in accordance with Part III of the MUTCD.

C. Materials for Temporary Pavement Marking: Temporary pavement marking tape, temporary road markers, or reflectorized pavement marking paint shall be of the type specified.

Temporary pavement markings shall be of the color specified.

1. **Temporary Pavement Marking Tape** shall be applied according to the manufacturer's recommendations. Tape used for dashed centerline marking shall be applied in four inch (100 mm) widths, two feet (600 mm) long with a cycle length of 40 feet (12 meters). A two foot (600 mm) stripe with a cycle length of 20 feet (six meters) may be used for roadways with severe curvature. Solid stripes shall consist of tape applied in four inch (100 mm) widths for the length specified.

2. **Temporary Road Markers** shall be applied according to the manufacturer's recommendations. Four inch (100 mm) wide reflectorized markers may be used in place of tape or paint.

   If temporary road markers are used to substitute for dashed centerline stripes, they shall be four feet (1.2 meters) long stripes with a cycle length of 40 feet (12 meters). A two foot (600 mm) stripe with a cycle length of 20 feet (six meters) shall be used for roadways with severe curvature. Two temporary road markers shall represent the stripe, one at each end of the stripe. A solid stripe will be represented by a five foot (1.5 meter) spacing.

   On asphalt seal projects temporary road markers shall not be placed more than 72 hours prior to covering the inplace markings on the surface. The protective marker covers shall not be removed until after all oil within two feet (600 mm) of the markers has been applied and rolling has been completed.

3. **Painted Temporary Pavement Marking** shall be applied as follows: Dashed centerline stripes shall be applied in four inch (100 mm) widths four feet (1.2 meters) long at cycle lengths of 40 feet (12 meters). A two foot (600 mm) stripe at cycle lengths of 20 feet (six meters) may be used for roadways with severe curvature. Solid stripes shall be four inches (100 mm) wide for the length specified or required.

   The paint applicator shall be a self-propelled pneumatic spraying machine with atomizing nozzles capable of applying a minimum of three lines at one time from 4 to 8 inches (100 mm to 200mm) wide.

   The pavement marking paint shall be applied at a minimum wet thickness of 15 mils, equivalent to a dry thickness of 7 to 8 mils (0.381 mm, equivalent to a dry thickness of 0.178 mm to 0.203 mm). Glass beads shall be applied on the wet paint line at a minimum of six pounds of glass beads per gallon of paint (0.720 kg of glass beads per Liter of paint). Restriping of temporary pavement markings to meet this requirement and to provide a quality retroreflective line shall be at the expense of the Contractor with no additional cost to the Department. Sections to be restriped shall be determined by the Engineer.

a. Tolerances:

1) The length of the painted stripe shall not vary more than plus or minus 3 inches (75 mm) from the plans requirement.

2) The width of the painted stripe shall not vary more than plus or minus 1/2 inch (12 mm) from the plans requirement.

3) The length of a 40 foot (12 meter) cycle length (painted stripe and gap) shall not vary more than 3 inches (75 mm).

4) The alignment from the plans requirement or existing markings shall not vary more than plus or minus 2 inches (50 mm).

5) The maximum longitudinal deviation from the existing markings at either end of the painted roadway segment shall not vary more than plus or minus 6 inches (150 mm).

6) Lane lines shall not deviate more than 1 inch (25 mm) per 200 feet (61 m), nor shall any deviations be abrupt.

Any markings that deviate outside these tolerances will be removed and replaced by the Contractor at no cost to the Department. Removal shall be performed utilizing equipment that is not detrimental to the final surface, as required by the Engineer.

When only one lane of a two-lane roadway is complete at the end of a day, the temporary marking shall be placed near centerline on the unsurfaced portion of the roadway.

D. Removal of Pavement Markings: Pavement markings to be removed shall be designated by the Engineer.

Pavement markings shall be removed from the pavement by methods that do not damage the surface or texture of the pavement. Pavement markings shall be removed before the traffic pattern is changed.

Covering the markings is not acceptable removal.

Sand or other material used for removal shall be disposed of as the work progresses. Accumulations of sand or other material, which interferes with drainage or constitutes a hazard to traffic, will not be permitted.

When sand blasting is used for removal of pavement markings or objectionable material, and the removal operation is performed within 10 feet (three meters) of a lane occupied by the traveling public, the residue including dust shall be removed immediately by a vacuum attachment operating concurrently with the sand blasting operation.

Damage to the pavement surface caused by pavement marking removal shall be repaired at the expense of the Contractor.

E. Temporary Traffic Signal System: When temporary traffic signal systems are specified, the system shall consist of signal heads, controller, and a power supply, all mounted on a heavy duty trailer. The temporary traffic signal system shall remain the property of the Contractor upon completion of the project.

Each individual unit of the system shall consist of two 3-section polycarbonate signal heads with 12 inch (300 mm) diameter signal indications. All traffic signals shall be equipped with tunnel visors and backplates. Backplates and tunnel visors shall have a dull black finish. One of the signal heads shall be mounted a minimum of 17 feet (5.2 m) and a maximum of 19 feet (5.8 m) above the roadway surface on the mast arm. The other signal head shall be mounted at least 8 feet (2.4 m) but not more than 15 feet (4.6 m) above the roadway surface. The signal heads shall meet or exceed all current ITE standards for Vehicle Traffic Control Signal Heads. The traffic signal system shall meet all requirements of the MUTCD.

The signal heads shall have the ability to be rotated 180 degrees to face in either direction. The signal heads shall also have the ability to be rotated in the vertical or horizontal plan so as to have the optimum visibility to the motorist. Signals shall be aimed such that all the signals for each approach shall be continuously visible for the minimum distance listed in the following table:

85^{th} Percentile Speed (mph)	Minimum Sight Distance (feet)
20	175
25	215
30	270
35	325
40	390
45	460
50	540
55	625
60	715

The individual units shall be able to withstand 80 mph wind gusts. The controller shall have an operating range from –40 to +120^{o} F (-40 to +49^{o} C).

The power source for the unit shall be one of the following: an engine generator unit, solar, or a 110 volt AC power source. Battery backup shall be provided and be able to operate the units for a minimum of 48 hours.

The temporary traffic signal units shall operate from one master controller. The second controller or slave unit shall be controlled by the master unit. The controller shall be capable of operating pretimed, actuated, or by manual control. The controller shall also have the ability to dwell in all red. The communication system shall be a FCC approved and licensed two-watt radio link. The radio communication system between the master unit and the slave shall be unaffected by any RF interference. The entire system shall be tamper and water resistant.

The failure mode of the system shall be an all red flash. The temporary traffic signal system shall be equipped with a default pager system. If a default condition exists, the temporary traffic

signal system shall send a page via a cellular phone to alert the Contractor of a failure. The system shall also have an audible alarm that sounds in the event of a failure of the system.

In the event of failure, the Contractor shall furnish necessary flaggers to safely control traffic until the temporary traffic signal system is operable. The cost of flaggers, signing, and lighting shall be incidental to the contract lump sum price for temporary traffic signal system.

The temporary traffic signal system detection shall operate in the presence mode.

The Contractor shall have a qualified individual responsible for setup and maintenance of the temporary traffic signal system. This person shall have received training on installation, setup, and maintenance of the system.

The temporary traffic signal system shall be equipped with work zone safety lights located on the back side of the signal heads to alert construction workers of the status of the traffic signal.

634.4 METHOD OF MEASUREMENT

Traffic control will be inventoried throughout the duration of the project. A record of the number and type of signs, channelizing devices, the number of flagger hours, and pilot car hours will be kept. The total units of traffic control devices, hours of flagging, and pilot car hours shown in the contract is estimated and may be adjusted in accordance to the needs of the project.

Measurement for Temporary traffic signal system will be made on a per site basis. One site will be considered to be two portable signal units (master and slave unit) with the necessary controller unit.

634.5 BASIS OF PAYMENT

Payment for traffic control will be made following satisfactory installation and will be the assigned unit value of the device multiplied by the contract unit price per unit. The assigned unit value for each traffic control device will be obtained from the sign tabulation in the plans. Payment will be full compensation for installation, maintenance, relocation, and removal.

Additional payment will not be made for any traffic control device turned away, covered up, taken temporarily out of service, and returned to use. If a traffic control device is relocated because of an error in the plans or by the Engineer, an additional 50 percent of the designated sign rate will be paid. Failure to maintain, relocate, or remove traffic control devices as required will result in monies being deducted from future estimates.

The cost of shadow vehicles, Type I and Type II barricades, cones, tubular markers, vertical panels, drums, lighting devices, flags, delineators, and other items noted on the plans shall be included in the lump sum contract unit price for traffic control, misc.

At locations shown on the plans to be paid for by the foot (0.1 meter), payment for temporary pavement markings will be made at the contract unit price per foot (meter). Measurement and payment for temporary pavement marking will be by the mile (kilometer). Payment will be inclusive

of all costs for the temporary dashed centerline, lane lines, no passing zone lines, and Do Not Pass and Pass with Care signing (if utilized).

Each surfacing lift or surfacing treatment receiving temporary pavement marking will be measured to the nearest tenth mile (100 meter) increment for payment. If a single set of temporary roadway markers is utilized on multiple surfacing courses, payment will be made as though each course was marked separately.

The cost of temporary pavement marking of sections of the roadway due to asphalt tack application will be incidental to other items of work. When only one lane of the final surface course or treatment on a two-lane roadway is complete at the end of a day the temporary marking placed near centerline on the unsurfaced portion of the roadway will not be paid for.

Hinged signs and signs with tabs, such as right and left signs will be paid for as one sign.

The cost of the designated traffic control contact person shall be incidental to the contract lump sum price for Traffic Control, Miscellaneous.

Flagging: The accepted number of flagging hours will be paid for at the rate specified in the Price Schedule for Miscellaneous Items.

Pilot Car: The accepted number of pilot car hours, including driver and auxiliary signs, will be paid at the rate specified in the Price Schedule for Miscellaneous Items.

Temporary Traffic Signal System will be paid for at the contract unit price per site. Payment will be full compensation for furnishing, installing, maintaining, and all other incidentals for the system.